

We Learn . . .

10% of what we read

Read the

20% of what we hear

readings

30% of what we see

Attend the

50% of what we see and

lecture

hear

Why I use
pictures and
participate!
videos

70% of what we discuss

80% of what we

Study groups

experience

-William Glasser

The Tragedy of the commons

- What is it?

The Tragedy of the commons

- The tendency of any resource that is unowned, and hence non excludable, to be overused and under maintained

- What is the price of the most expensive fish to date?

The world's second priciest fish purchased for just under \$2 million

Nothing fishy here, just a fresh 608-pound bluefin tuna

By [Anne Wallace](#) Jan 7, 2020, 12:48pm MST



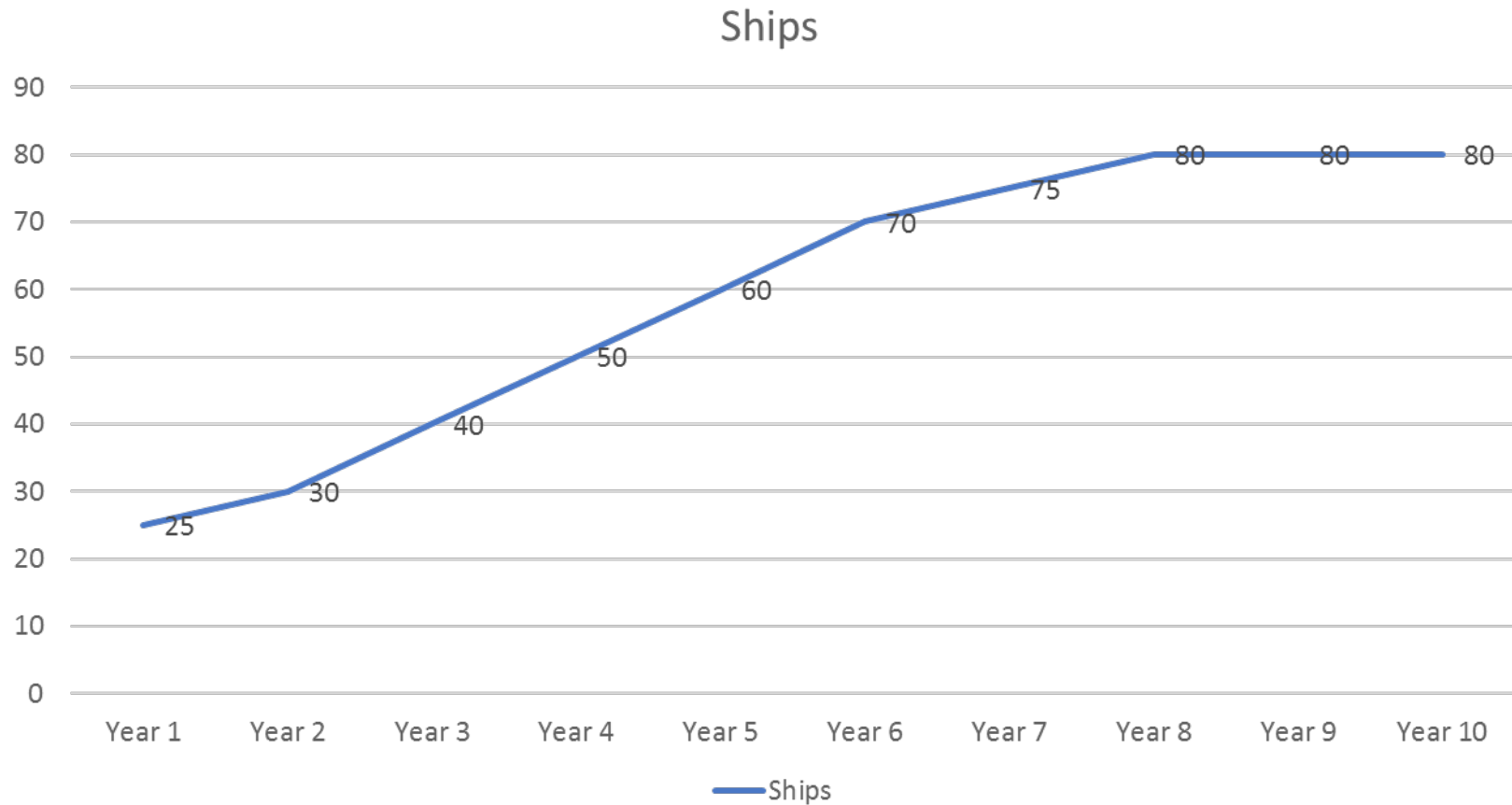
Fishbanks

What Strategy did you pursue?

Aggressive?

Conservative?

Typical Game Behavior: Fleet



Fishbanks

How much money did you
make?

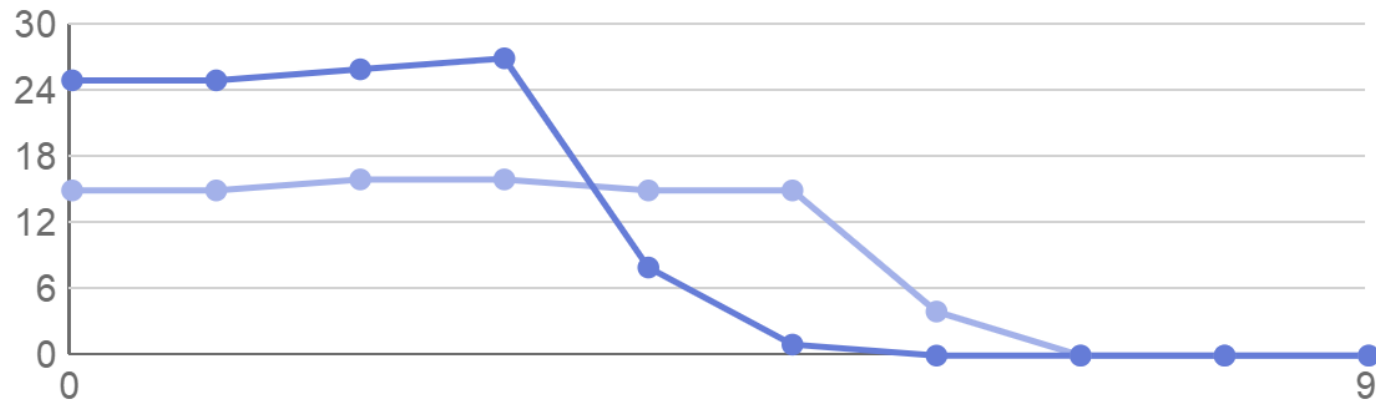
The winning team is....



Group ne,
Cheryl MA, Cory
Christensen
\$122,656 at year 15!

What happened after year 10? What did you observe?

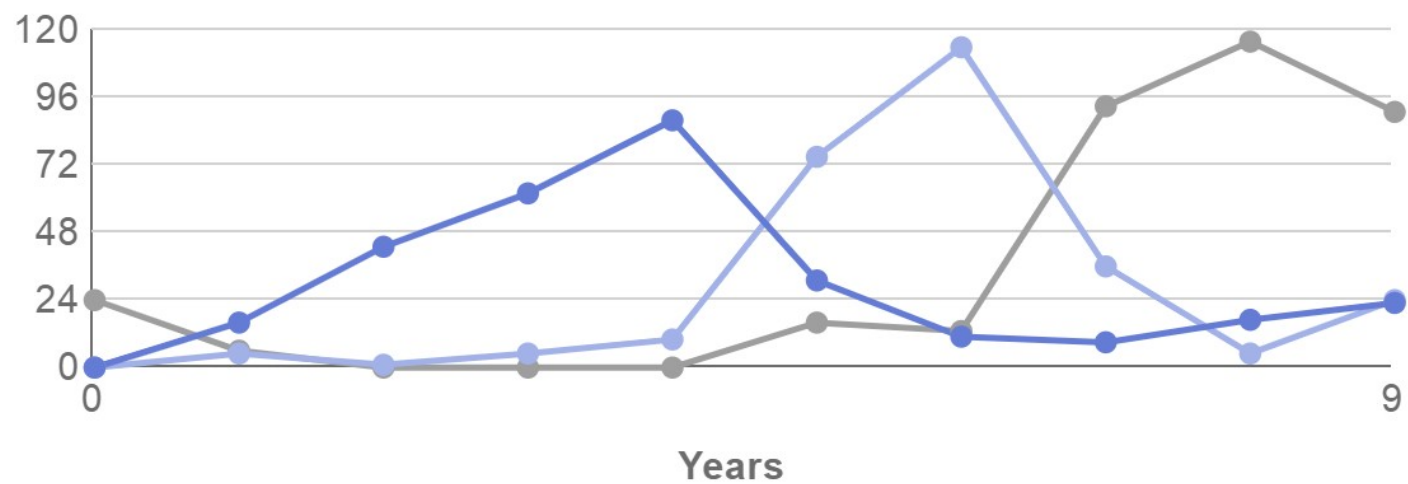
Expected Catch per Ship (Fish/Year/Ship)



Coast Deep

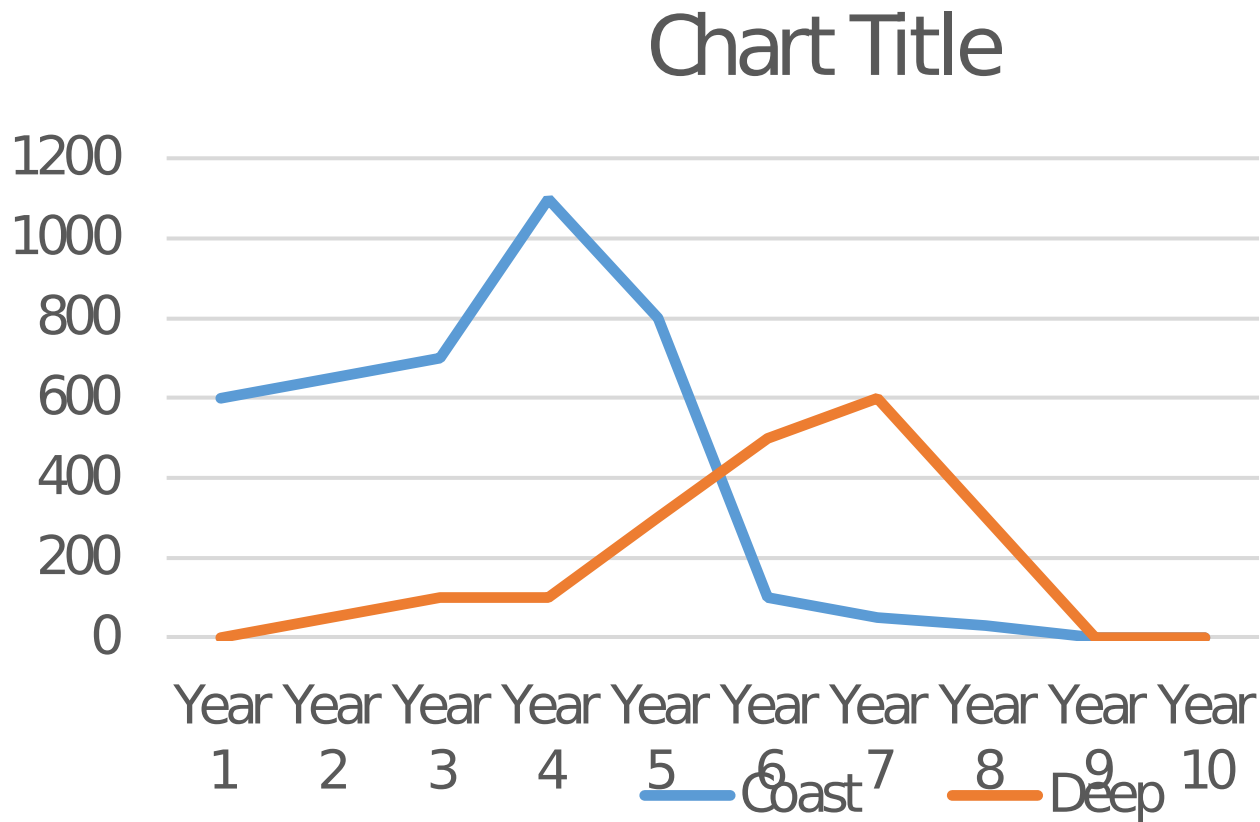
View results for: Ocean 1 ▼

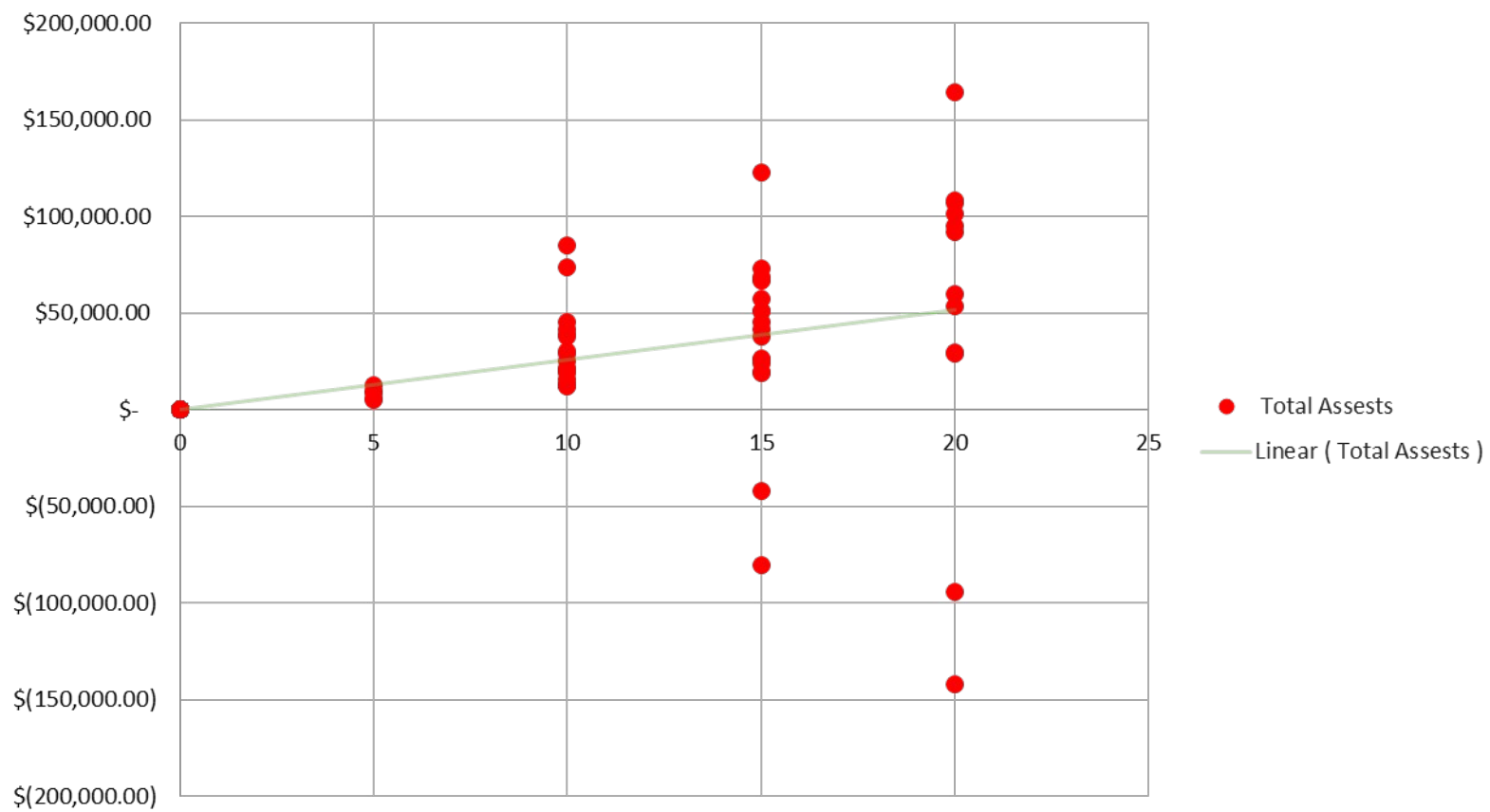
Ships Allocations in the Ocean (Ships)



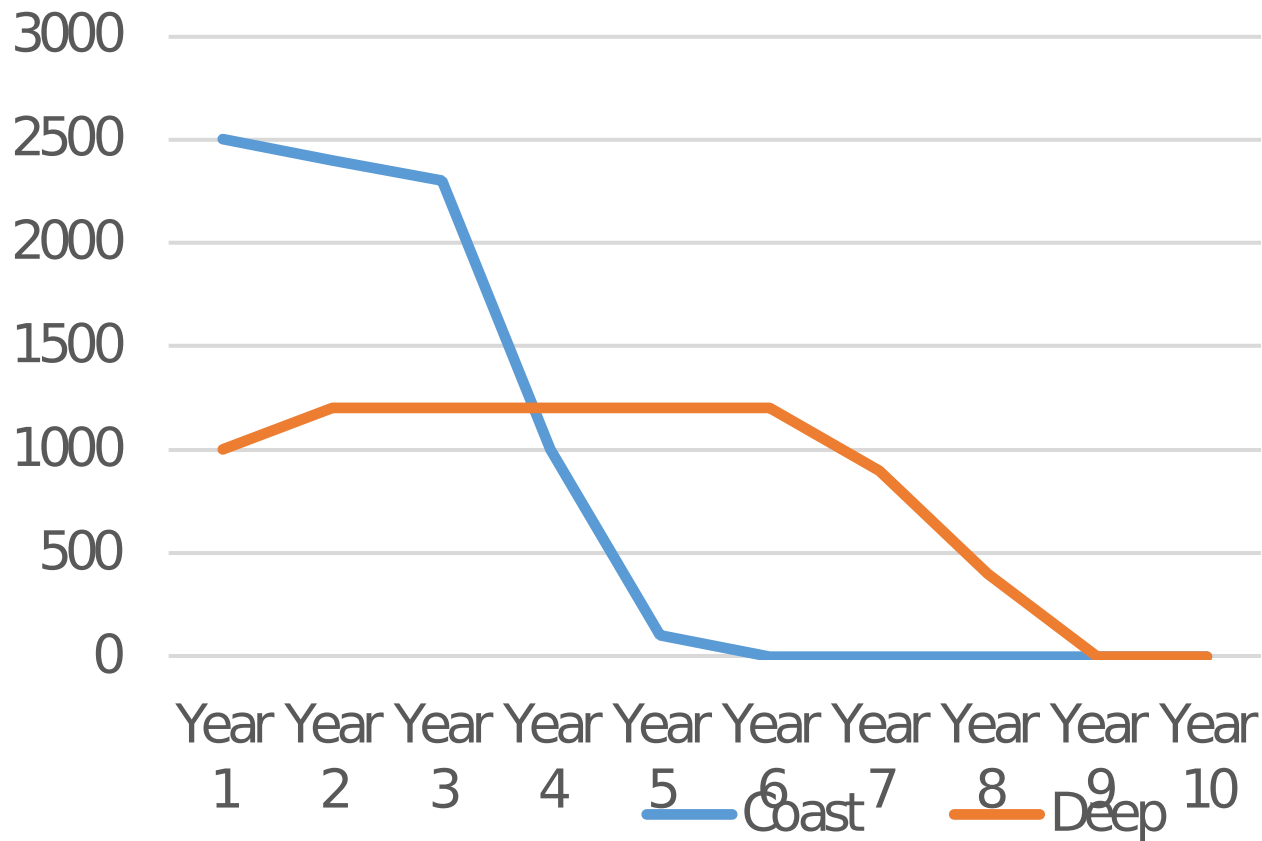
Harbor Coast Deep

Typical Game Behavior-- Catch





Typical Game Behavior- Fish Population



What happened?
What are the causes of the
collapse?

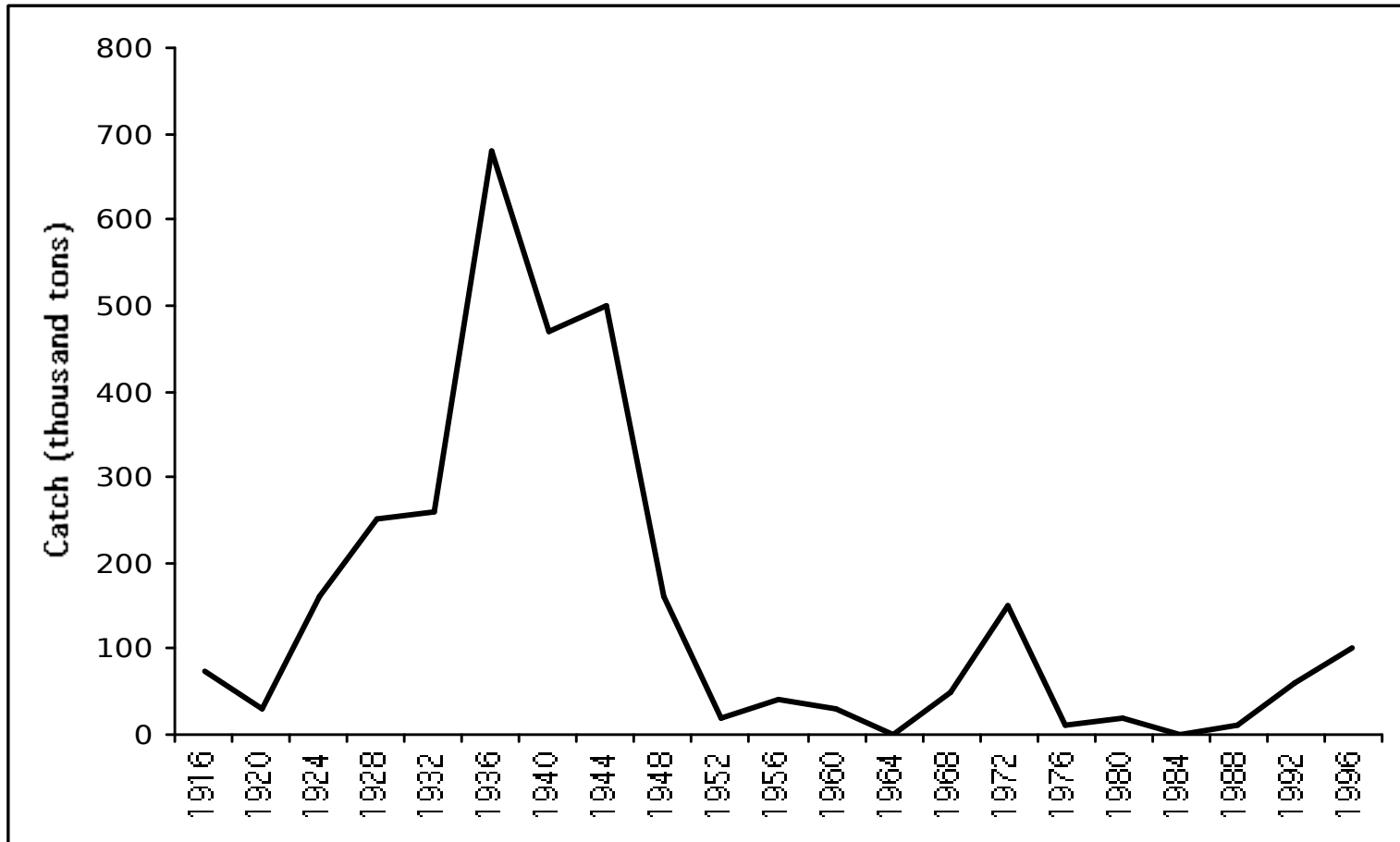
Fishbanks: causes of collapse?

- Misinformation issues
 - Difficulty to assess the evolution of the fish population
 - assumptions of stability
 - What happened? We sent ships but there is no catch?
- Delay in control response
 - unfeasibility of unilateral control measures
 - lack of trust?
- Limited time horizon
 - 10 year game
 - 20 year game

Does fish depletion happen in real life?

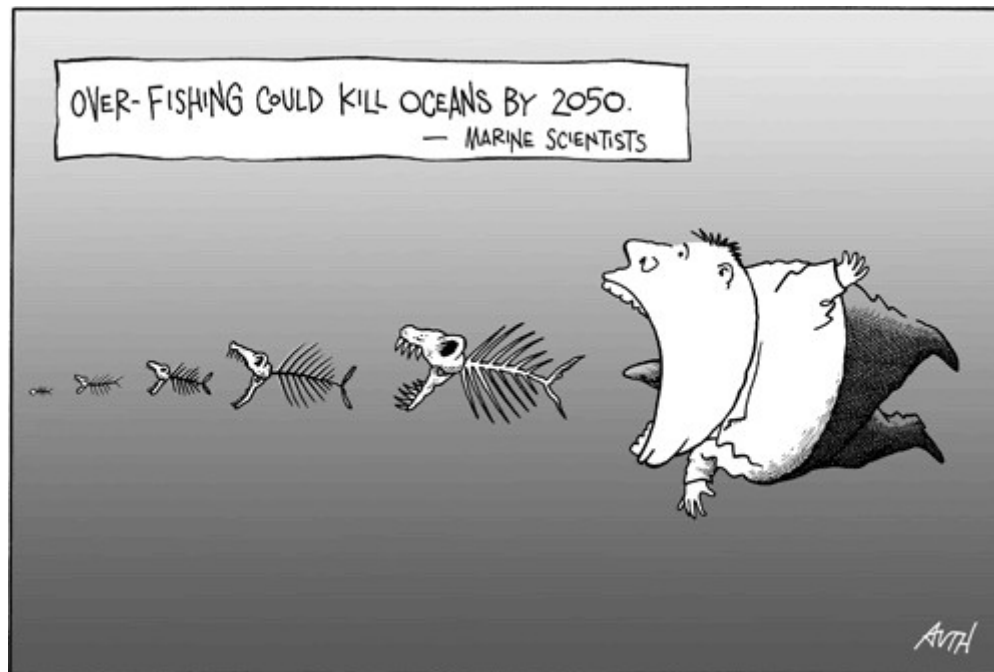
- Pacific Sardine
- Peruvian Anchovy
- North Sea Herring
- Atlantic Swordfish
- Atlantic Cod
- Etc...

Pacific Sardine Catch



Ocean empty of fish by 2048?

- November 2006 study on global fisheries:
 - Boris Worm predicted that by 2048 the ocean would be empty of fish, employing 53 years worth of fishery data

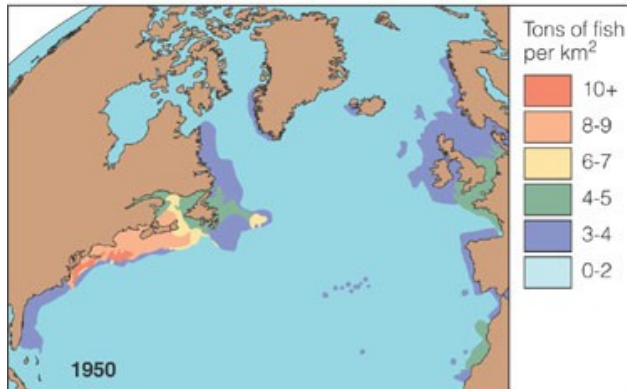


11-21-06 THE PHOENIX NEWS-STAR. ILLUSTRATION BY AVTH.

Regionally, nonrenewable....

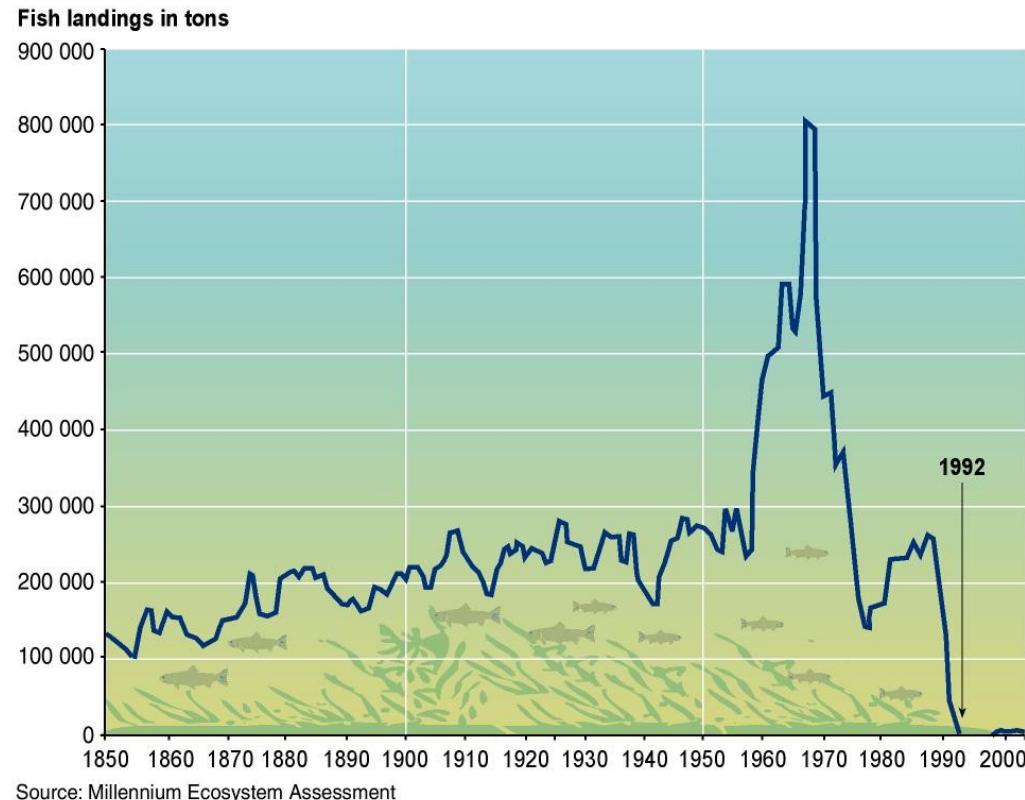
Overfishing of N. Atlantic has depleted fish stocks 1900-1999

Cod “so thick that you could walk on them” drew the Vikings to the New World.

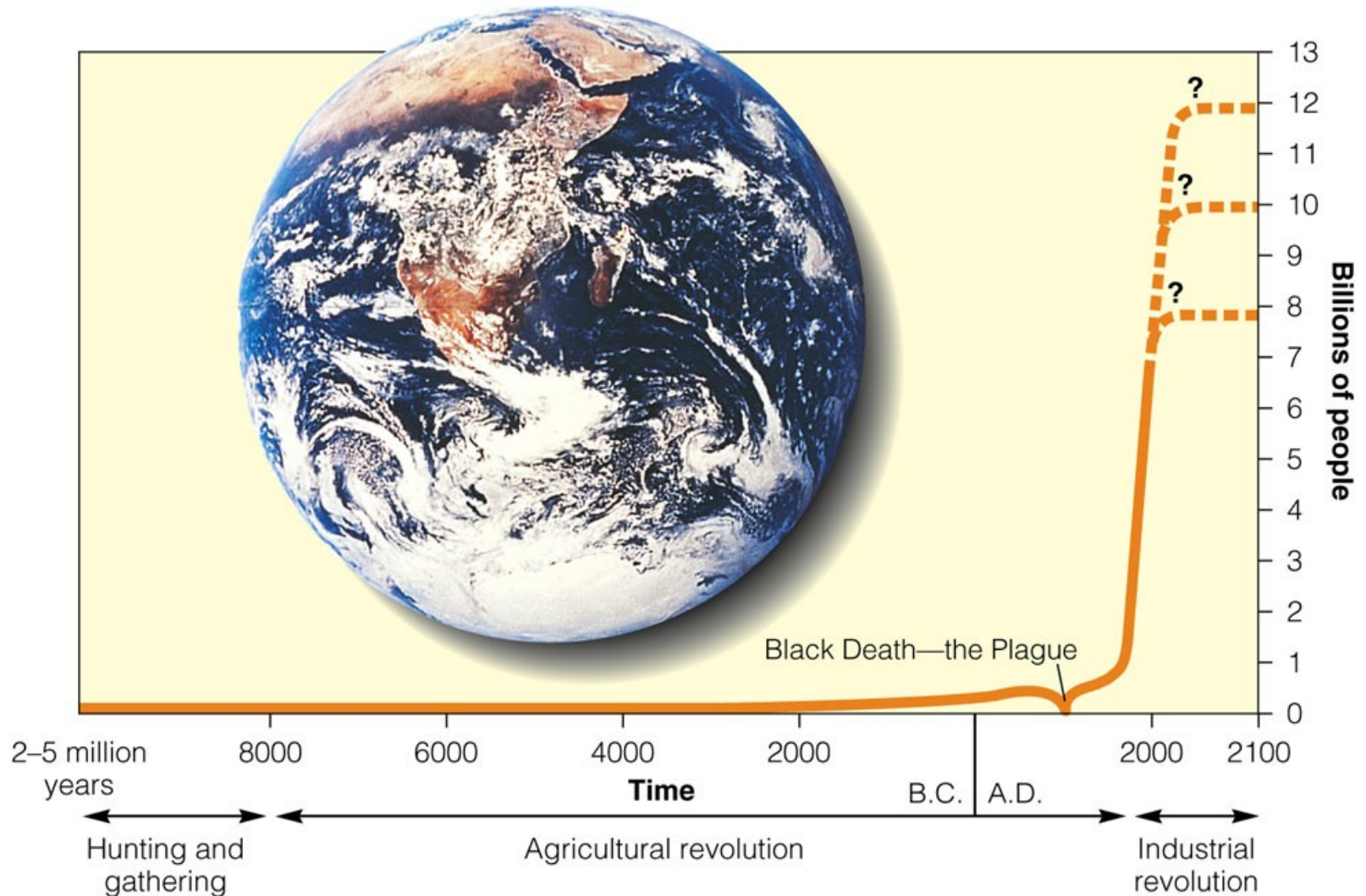


Cod stocks

- The Atlantic cod stocks off the east coast of Newfoundland collapsed in 1992, forcing the closure of the fishery
- Cost ~\$2 billion in income support and retraining
- Depleted stocks may not recover even if harvesting is significantly reduced or eliminated entirely



The Human Population Picture



The **Big** Question

- Fish Populations are declining
- The Human Population is increasing exponentially
- What can be done to sustain fish as a viable food resource for the human population?

Tragedy of the Commons

- Popularized by Hardin (1968)
- One of the most influential theories for resource- management policy

Tragedy of the Commons

- Popularized by Hardin (1968)
- One of the most influential theories for resource- management policy
- The model:
 - Private gains hold social or ecological costs
 - Benefits gained by individual, costs borne by all
 - Incentive to put more cattle on the commons as long as personal gain is more than personal cost
 - Common-pool resources subject to ruin

What are common resources?

What are common resources?

	EXCLUDABLE	NONEXCLUDABLE
RIVAL	Private Goods House Pasta Sunglasses	Common Resources Fish in the Ocean The environment Public roads
NON RIVAL	Club Goods Cable TV Wi-Fi Digital music	Public Goods Asteroid deflection National defense

Common resources are rival in consumption but not excludable.

Chicken Farm



Farmer : if I sell less chicken today, I will be able to sell more tomorrow. I own the stock of chickens



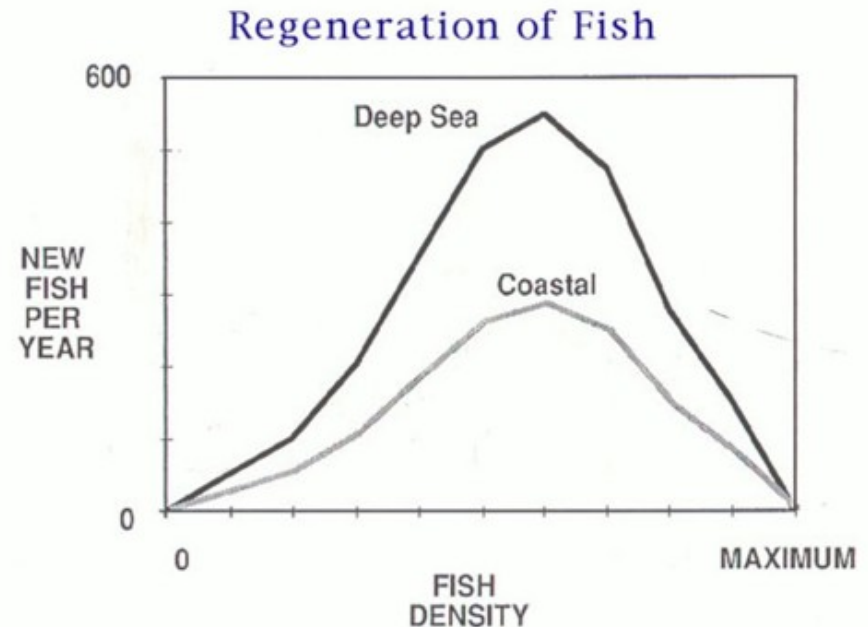
Fishery

Fisherwoman: if I conserve today that doesn't leave me with more fish tomorrow. I don't have an incentive to maintain the stock.

Turning point is too late

Hardin suggests that there is a turning point at which an individual's marginal gain from adding one more animal to his herd – as it feeds on the commons -- is no longer greater than the marginal costs;

However, this point is far beyond that of the maximum sustained yield or the sustainable productivity of the system



What are other examples
of common resources?





How to avoid the tragedy
of the commons?

How to avoid the tragedy of the commons?

- Information

- Need a to have information about resource depletion
- Criterion of judgment on common resource versus private benefit. Weighting system.

- Coercion

- Free riding issue even if everyone agrees with objective of common resource protection
- Which institution should coerce?

- Private Property

What can be done
to avoid the
collapses of
fisheries?

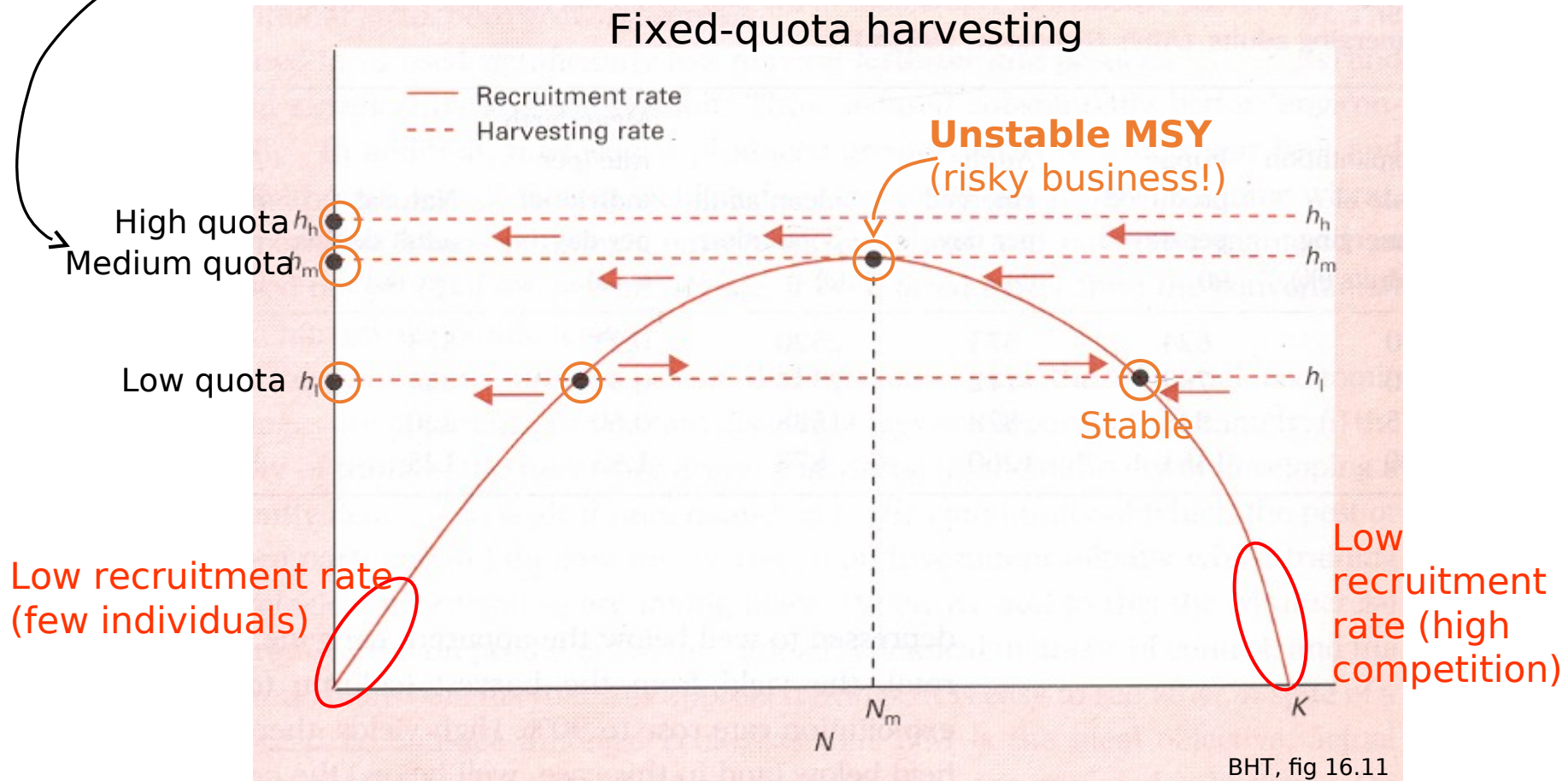
What can be **done?**

- Information
 - Develop better methods for stock assessment
- Regulation
 - Partition the seas
 - Establish quotas
 - Limit ship fleets, technology
- Norms
 - Change consumption preferences
- Property rights
 - Farm fish
 - Catch shares and Individual Transferable Quotas (ITQs)

Information

Harvesting of Population

Maximum Sustainable Yield (MSY): fixed quota



MSY: the highest harvesting rate that the population can match with its own recruitment

Information requirements for fisheries' management

- Measurement of fish caught
- Knowledge of fish biology
- Population size (tagging)
- Age
- Reproductive biology

Regulation

The 1982 International Law of the Sea

- Territorial waters
 - 12 nautical miles from shores
 - Nations have sole jurisdiction here
- Exclusive Economic Zone
 - 200 nautical miles from shore
 - Nations control resources here
- High Seas
 - Beyond 200 miles from any shore
 - Common property for all people

Marine reserves

- “Fishes in protected zones may experience with overfishing occurring around them... Although their population may not be completely wiped out, they are still heavily influenced by the fisheries around them.”
- “The weak point is that, because we limited the fishing zones to 50% of the total area, the ships were depleting the zones that were not protected. Here, we see the tragedy of the commons once again.”



Allocate property rights

Can Catch Shares Prevent Fisheries Collapse?

- In a catch share, fishermen are allotted a portion of a total allowable catch that they can harvest whenever they want, or trade or sell their share
- As the fish population recovers and the total allowable catch is raised, the price of each share goes up.
- Instead of simply catching fish from one day to the next, catch shares are built to make shareholders keep a constant eye on the future health of the fish population.
- Examples of catch shares are individual transferable quota (ITQs), individual fishing quotas (IFQs), territorial use rights for fishing (TURFs), limited access privileges (LAPs), sectors (also known as cooperatives), and dedicated access privileges (DAPs).

Catch share fisheries

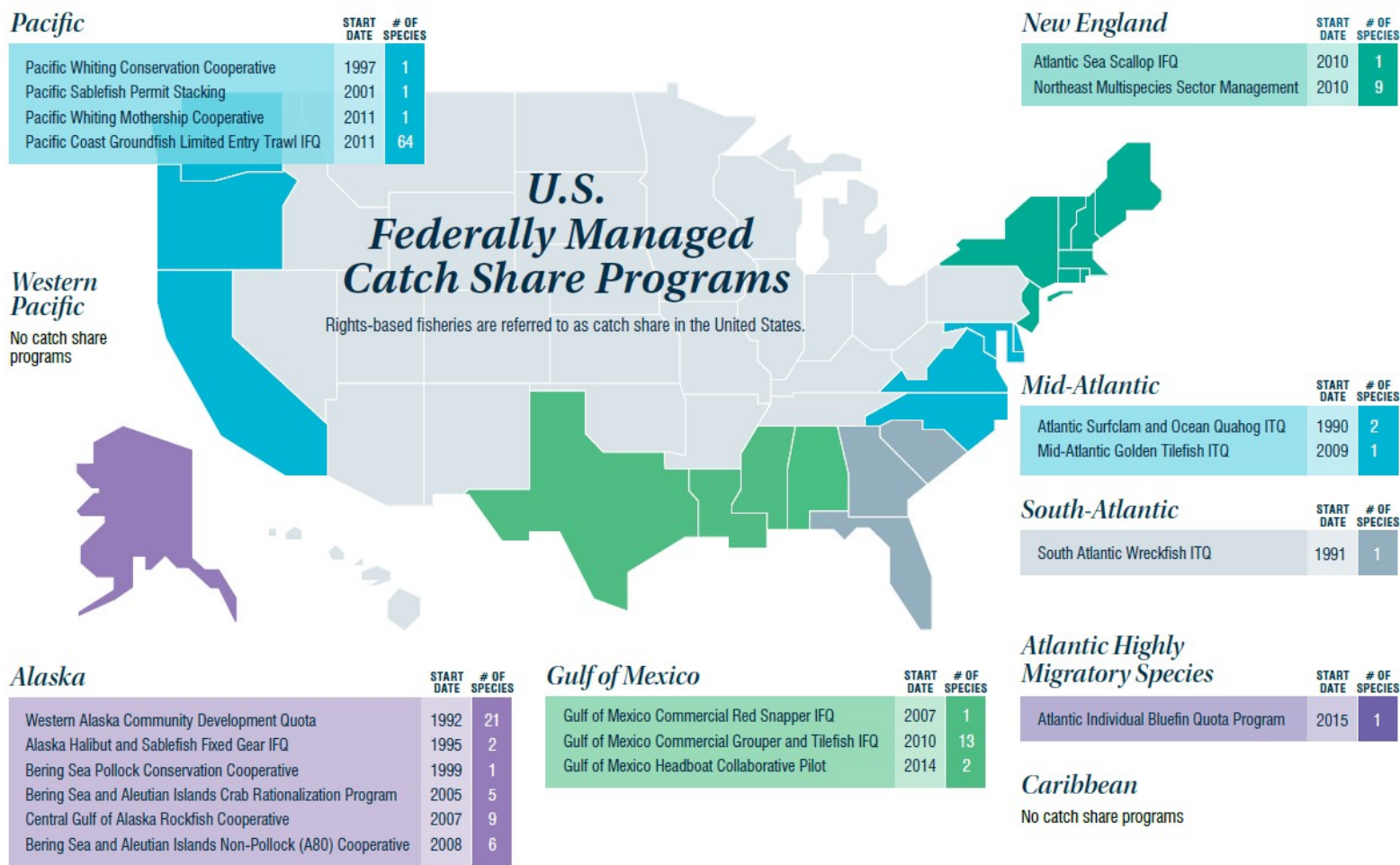


FIGURE 1. Federally managed US rights-based fisheries (RBF) programs across regions, organized by fishery management plan, its start year, and the number of species managed by that program.

- Watch video in breakout room
- <http://www.youtube.com/watch?v=pYSDVleHvb4>
(3min)

Catch shares

- “ Catch-share is an effective **long-term** management strategy. It does not rapidly deplete the fish population, so I can likely depend on having a consistent number of catches each year if the limit is low enough for fish populations to sustain themselves.
- Furthermore, I would **not have to buy more ships** or equipment, saving me a large sum of money. Thus, in the long term I would profit much more to have few ships and consistent catches each year than if I had many ships but rapidly depleted the fish population so that in a few years I would be in debt.
- And, I do **not have to worry about other companies** exploiting the fish population for more profits and threatening my own success.”

Catch shares

- "Under open access, you have a free-for-all race-to-fish, which ultimately leads to collapse..."
- "But when you allocate shares of the catch, then there is an incentive to protect the stock—which reduces collapse. We saw this across the globe. It's human nature."

Christopher Costello

- <http://www.youtube.com/watch?v=pYSDVleHvb4> (3min)
- <http://www.youtube.com/watch?v=dE1qpzw-lcE> (5min)
- <http://www.youtube.com/watch?v=xDgneuJ8mkQ&feature=related>
(3min)

Farming

Trade-Offs

Aquaculture

Advantages

Highly efficient

High yield in small volume of water

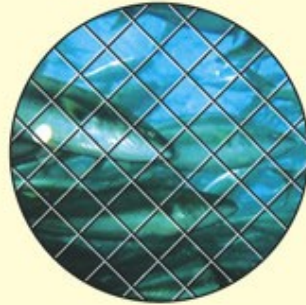
Increased yields through cross-breeding and genetic engineering

Can reduce over-harvesting of conventional fisheries

Little use of fuel

Profit not tied to price of oil

High profits



Large inputs of land, feed, And water needed

Produces large and concentrated outputs of waste

Destroys mangrove forests



Increased grain production needed to feed some species

Fish can be killed by pesticide runoff from nearby cropland

Dense populations vulnerable to disease



Tanks too contaminated to use after about 5 years

[Aquaculture Methods](#)

[Is Aquaculture the Answer?](#)

Solutions

More Sustainable Aquaculture

- **Reduce use of fishmeal as a feed to reduce depletion of other fish**
- **Improve pollution management of aquaculture wastes**
- **Reduce escape of aquaculture species into the wild**
- **Restrict location of fish farms to reduce loss of mangrove forests and other threatened areas**
- **Farm some aquaculture species (such as salmon and cobia) in deeply submerged cages to protect them from wave action and predators and allow dilution of wastes into the ocean**
- **Set up a system for certifying sustainable forms of aquaculture**

Change consumption
norms

Influence consumer consumption?





BEST CHOICES

Abalone (US farmed)
 Arctic Char (farmed)
 Barramundi (US farmed)
 Catfish (US farmed)
 Clams, Mussels, Oysters (farmed)
 Cod: Pacific (Alaska longline)
 Crab: Dungeness
 Halibut: Pacific
 Lobster: Spiny (US)
 Rockfish: Black (CA, OR, WA, hook & line)
 Sablefish/Black Cod (Alaska, BC)
 Salmon (Alaska wild)
 Sardines: Pacific (US)
 Scallops (farmed off-bottom)
 Shrimp: Pink (OR)
 Striped Bass (farmed or wild*)
 Tilapia (US farmed)
 Trout: Rainbow (farmed)
 Tuna: Albacore including canned white tuna (troll/pole, US and BC)
 Tuna: Skipjack including canned light tuna (troll/pole)
 White Seabass

GOOD ALTERNATIVES

Caviar, Sturgeon (US farmed)
 Clams, Oysters (wild)
 Cod: Pacific (US trawled)
 Crab: King (US), Snow
 Flounders, Sanddabs, Soles (Pacific)
 Halibut: California*
 Lobster: American/Maine
 Mahi Mahi/Dolphinfish (US)
 Pollock (Alaska wild)
 Rockfish (Alaska or BC, hook & line)
 Sablefish/Black Cod (CA, OR, WA)
 Salmon (wild, WA and north of Cape Falcon, OR)*
 Scallops: Sea
 Shrimp (US, Canada)
 Spot Prawn (US)
 Squid
 Swai, Basa (farmed)
 Swordfish (US)*
 Tilapia (Central America farmed)
 Tuna: Bigeye, Yellowfin (troll/pole)
 Tuna: Canned white/Albacore (troll/pole except US and BC)

AVOID

Caviar, Sturgeon*
 Chilean Seabass/T
 Cod: Atlantic, impo
 Cobia (imported fa
 Crab: King (imported)
 Dogfish (US)*
 Lobster: Spiny (Brazil)
 Mahi Mahi/Dolphinfish (imported)
 Marlin: Blue*, Striped*
 Monkfish
 Orange Roughy*
 Rockfish (trawled)
 Salmon (farmed, including Atlantic)*
 Salmon (wild, CA and south of Cape Falcon, OR*)
 Sharks*
 Shrimp (imported)
 Swordfish (imported)*
 Tilapia (Asia farmed)
 Tuna: Albacore, Bigeye, Yellowfin (longline)*
 Tuna: Bluefin* and Tongol
 Tuna: Canned (except troll/pole)*



Conclusion

- Tragedy of the Commons
 - Private gains hold social or ecological costs
 - Common-pool resources subject to ruin
- Examples of Tragedy of the Commons
 - Climate Change
 - Pollution
- Solutions
 - Information
 - Coercion
 - Norms
 - Private Property

Tuesday - Climate Change Regulation

- Study one program
 - U.S. Acid Rain Program:
 - Emission Trading in the E.U.
 - South Air Quality Management District Reclaim Program
 - CA Cap and Trade
- Respond to quiz questions on CCLE
- The quiz is there to help you better understand the cap and trade program you have chosen